

# HEATHKIT VISUAL-AURAL SIGNAL TRACER

## MODEL T-3



### FEATURES AND APPLICATIONS

High gain RF channel for direct observation of actual transmitted signal. Can be used for AM, FM and TV circuit investigation.  
Low gain channel for audio circuit exploration.  
Visual signal indicator.  
Convenient wattmeter circuit.  
Noise locator circuit.  
Utility amplifier for checking record changers, tuners, etc.  
Useful for checking microphones, musical instrument pickups and speakers.  
Substitution test speaker and output transformer.  
Oscilloscope preamplifier.  
VTVM panel terminals.  
Output meter.

### TUBE COMPLEMENT

12C8 amplifier and wattmeter rectifier.  
12SH7 high gain pentode amplifier.  
12A6 beam power output.  
1629 electron beam visual indicator.  
6X5 full-wave rectifier.

### PROBES AND TEST LEADS

Shielded RF probe and lead.  
Audio probe and lead.  
Two flexible panel test leads with alligator clips.

### SPECIFICATIONS

Cabinet size  $9\frac{1}{2}$ " wide  $6\frac{1}{2}$ " high 5" deep.  
Shipping weight 8 pounds.  
Power requirements 110 to 120 volts AC at 50-60 cycles.

- (A) Install the 1629 tube in the socket and snap the base of the tube into the spring mounting clip in such a manner that allows the end of the tube to project slightly through the panel opening provided. The socket keyway should be pointed towards the chassis.

In the remaining wiring steps involving the connections from the beam indicator socket to the T-3 chassis, allow sufficient lead lengths that will permit removal of the tube from its spring base clamp. Dress wiring as shown in pictorial 3.

- (A) Connect the twisted pair of filament wires from the round octal socket to J2 (S) and J7 (S).  
(J) Connect the lead from lug 4 of the round octal socket to one lug terminal strip R (S).  
(A) Connect the wire from lug 5 of the round octal socket to B8 (S). Dress this lead as shown in pictorial 3.  
(A) Connect the wire from lug 8 of the round octal socket to a ground solder lug on socket K (S).

This completes instrument wiring and the panel knobs can now be installed. With a small screw driver, install the set screws in the pointer knobs.

Panel controls A, B and D should all be rotated to extreme counterclockwise position. The pointer knob for the gain control should be tightened on the shaft at the rotation starting point.

The switch pointer knob should be tightened on the shaft at the TRACER position.

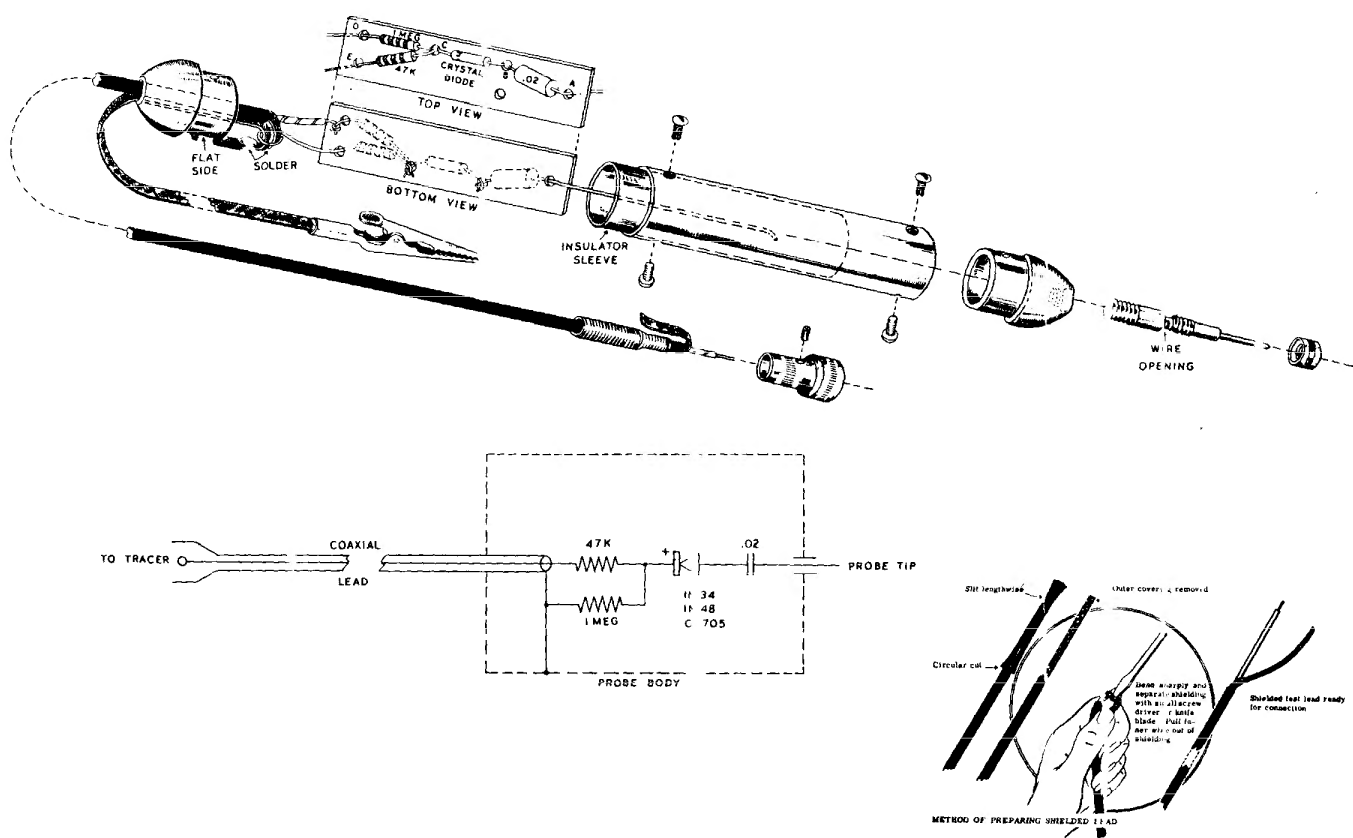
The wattmeter knob should be tightened on the shaft at the OFF position.

Install a 12C8 tube in socket F, a 12SH7 tube in socket G, a 12A6 tube in socket J and a 6X5 rectifier tube in socket K.

The aluminum handle should be fastened to the top of the cabinet by using the screws provided. The four rubber mounting feet should be slipped into the mounting holes on the bottom of the cabinet with the flat surface on the outside. The instrument and cabinet are now ready for final assembly but preliminary tests should be made before installation. Chassis installation merely requires that the sheet metal screws be installed in the rear of the cabinet to engage the holes provided in the rear of the chassis. Then by tightening the screws, the chassis and panel are drawn into proper alignment with respect to the cabinet. Be sure that the panel edge properly fits the cabinet flanges.

### PROBE ASSEMBLY

- (A) Place the probe insert terminal board as shown and mount a .02  $\mu$ fd condenser by placing the leads through holes A and B. The lead through hole A should be bent forward and the other lead toward the unused hole.
- (A) Mount the crystal diode in a similar manner, placing the leads through holes B and C. The end marked with a band or designated as the cathode should face hole C. Twist the wires coming through B together and solder. Avoid excessive use of heat as otherwise the diode may become damaged. The use of a damp cloth or pliers to quickly quench or remove the heat from the connection is advisable. Cut off the excess wire leaving about 1/4" appearing through hole B. Bend these wires toward the unused hole to lock the parts in place.
- (A) Install a 1 megohm resistor (brown-black-green) with leads through holes C and D.
- (A) Mount a 47  $\text{k}\Omega$  resistor (yellow-violet-orange) with leads through holes C and E. Twist the wires coming through hole C together and solder, observing the previously mentioned cautions regarding excess heat. Cut wires to a length of 1/4" and bend over to lock parts in place.
- (A) Place a length of flat braid and the large shielded insulated cable through the black probe end. Remove 1" of black outer insulation. Push the braid back until a bulge develops near the end of the black insulation. Bend the end over, poke a hole in the shield braid with a sharp tool and pull the center conductor through. Bend the shield braid and flat braid back together over the flat portion of the probe end and solder together. Make sure that the two braids are as flat as possible or it will be difficult to install the probe body.



- ( ) Fit the insulator strip tight against the probe end and solder the wire coming through hole D to the two braids near the center conductor.
- (✓) Cut the center conductor to length sufficient to reach the lead coming through hole E. Strip away 3/16" of insulation and solder the center conductor to the wire through hole E. Cut off all excess wire.
- (★) Install the insulator sleeve in the probe body and slip the entire assembly over the insulator board and probe end. Secure with two self tapping screws.
- (✓) Insert the phone tip in the red probe end. Tighten securely and remove the collar on the phone tip. Push the long wire of the .02  $\mu$ f capacitor through the hole in the phone tip and secure the front probe end with the remaining two self tapping screws. Wrap the wire around the probe tip and replace the collar.
- (X) Solder an alligator clip to the free end of the flat flexible braid.
- (✓) At the opposite end of the cable, push the microphone connector spring over the cable with the smallest diameter facing out as shown. Strip away 1" of the black outer insulation. Push the shielding braid back and pull the center conductor through the side of the shielding as before. Bend the shielding over the spring. Strip about 3/16" of insulation from the center conductor and tin the exposed wire. Slide the spring and wire assembly into the body of the connector, making sure that the center wire comes through the holes in the center of the connector. Tighten the set screw on the connector body and solder the wire appearing through the hole. Cut off any excess wire.

## AUDIO PROBE ASSEMBLY

- (+) Remove about 3" of the black insulation from one end of the remaining length of 36" black shielded test lead.
- (+) From the same end of the shielded test lead, remove about 1" of the shielded braid.
- (X) Next, expose about  $\frac{1}{2}$ " of the bare inner conductor.
- (X) Solder a length of flat shielded braid to that portion of the exposed shielding on the test lead that is nearest to the insulation or farthest from the end of the wire. Avoid excessive use of heat to prevent possible damage to the inner insulation and the flat shielded braid should be parallel to the test lead and the free end towards the remaining long length of lead.
- (X) Unscrew the collar on the tip of the black probe housing and install the test lead in the opening provided near the tip. The exposed portion of wire should then be wrapped in a clockwise rotation around the tip and the collar firmly assembled to the probe tip.
- (X) Solder an alligator clip to the free end of the flat flexible braid.
- (X) Remove the black sleeve from the phone jack and slip it over the length of black shielded test lead.
- ( ) Prepare the remaining end of the black shielded test lead in the same manner as described for the 432-1 connector.
- ( ) Connect the inner wire of the test lead to the inner terminal of the phone plug and the shielded braid of the test lead to the outer terminal of the phone plug. Solder both connections and screw on the black insulated portion and construction of the audio probe is completed.

## PREPARATION OF TEST LEADS

- ( ) Remove about  $\frac{1}{2}$ " of insulation from both ends of the 24" flexible test leads.
- ( ) Solder an alligator clip to one end of each test lead.
- ( ) Banana plugs should be fastened to the remaining test lead ends using the small set screw to fasten the lead to the plug.

Note the versatile construction of the binding posts on the T-3 panel. These posts will accommodate a simple wire connection in the usual manner. The top of the binding post will accommodate a banana plug. Spade lug terminals can also be attached to the binding posts and alligator clips will fit into the top of the binding post or can be clipped partially to the top of the binding post. The design of the binding posts will permit utilization of other shop test leads for specialized application of this instrument.

## IN CASE OF DIFFICULTY

When properly constructed, the T-3 Visual, Aural Signal Tracer should be capable of performing the following preliminary tests. The instrument should be turned on and after a normal fifteen or twenty seconds of operation, the level indicator tube will display a characteristic green color. This will indicate that the power supply system is functioning. The panel switch should be set to the "Tracer" position and gain control advanced to near maximum. Both the RF and Audio probes should be connected to the panel for these tests. The RF panel switch should be in the on position and the speaker should also be in the on position. Touching the tip of the RF probe should produce a loud humming sound from the Signal Tracer speaker and also will produce a closing of the shadow angle in the electron beam level indicator tube. Touching the tip of the audio probe should produce a much lower output buzzing or humming sound and a corresponding reduced action of the electron beam indicator tube shadow angle. In event your instrument is not capable of performing these preliminary tests, may we suggest that you observe the following procedure:

First of all, quickly check all components through visual inspection for a possible condition of overheating. If any of the resistors become excessively hot, the instrument should be turned off before proceeding with further tests. Disconnect the RF probe and touch the grid cap of the 12C8 tube. Be sure that the RF panel switch is in the on position and that maximum gain setting

is being used. If a loud buzz or hum is heard in the speaker, this would indicate that the fault lies in the construction of the RF probe and this particular assembly should be very carefully rechecked.

Assuming that no signal output is heard from the speaker, the chassis should be turned over and the #3 terminal of panel control A touched with the finger. Correct operation would be indicated by a relatively low buzz or hum in the speaker. Lack of operation could be due to a faulty tube particularly if the panel level indicator is functioning properly. The tube to suspect would be the 12C8. After a few moments of operation, the 12C8 and the 12SH7 tubes will become warm to the touch. The 12A6 and 6X5 tubes will become quite hot and some precaution should be taken to avoid a burn when touching these tubes.

The most common mistakes made in instrument construction can be classified as incorrect identification and circuit placement of resistors and condensers. All wiring should be very carefully checked and the mounting of parts should be checked to insure that all construction complies with the manual.

The use of a VTVM or a Voltmeter will be found extremely helpful. To make voltage measurements, it is merely necessary to connect the negative or black test lead to the chassis, as the chassis is used for a reference point in determining all operating voltages. On the schematic, the correct plate and screen voltages of all three amplifying tubes are indicated. The proper voltages of the power supply system are also shown. Due to variation in line voltage, component tolerance and tube operating characteristics, it would be reasonable to allow a tolerance of plus or minus 15 percent from the voltages stated.

Should inspection reveal the necessity for replacement of a component, write to the Heath Company immediately. The following information should be supplied in all cases:

- A. Thoroughly identify the part in question by using the part number and description found in the manual parts list.
- B. Identify the type and model number of kit in which it is used.
- C. Mention the order number and date of purchase.
- D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. Please do not return the defective component until specifically requested to do so. Do not under any circumstances dismantle the component in question as this will void the guarantee. If tubes are to be replaced, pack them carefully to prevent breakage in shipment as broken tubes are not eligible for replacement.

## CIRCUIT DESCRIPTION

The Model T-3 Signal Tracer is a transformer operated, three stage, high gain instrument that permits visual observation of the signal as well as the usual aural indication. The circuit features dual input channels that can be classified as RF or high gain input and audio or low gain input. The gain control in the grid circuit of the second or low gain stage effectively controls both channels. A grid shorting switch has been incorporated in the high gain stage so that tube noise will not interfere with low gain applications of the instrument. Additional features are a built-in wattmeter, noise locator and substitution test speaker and output transformer.

The pentode section of a 12C8 tube is used in the high gain channel. The diode plates are tied together and provide the necessary rectification for the wattmeter circuit. A 12SH7 is used in the second stage and is pentode connected and coupled into the conventional 12A6 beam power output stage. The output stage utilizes a tapped output transformer so that push-pull output transformer connections may be available for substitution purposes. A panel switching arrangement in the grid circuit of the 12SH7 tube allows the grid to be used for low gain Signal Tracer applications or permits the application of a DC test voltage to the low gain probe, so that the components in a circuit can be checked through voltage application. A coupling condenser permits the amplification of the test voltage action in the component under test.

In addition to panel terminals provided for test speaker use, a voice coil switch is available so that the speaker in the Signal Tracer or an external speaker can be used. To prevent erratic output indications and possible damage, a 47 ohm loading resistor is connected across the output transformer secondary.

Wattmeter indication is obtained by placing the device under test in series with the primary of a separate current transformer. The voltage developed across the secondary is then rectified by the diode plates of the 12C8 and measured in terms of a calibrated wattmeter scale.

A four section electrolytic filter condenser is used to provide maximum filtering for the necessary hum free operation of this instrument. The inherent hum level is extremely low and the hum heard while using the high gain or RF input can be classified as grid hum. This is understandable when consideration is given to the fact that the probe circuit represents an extreme extension of the input 12C8 grid circuit.

It is reasonable to expect some hum while using the high gain input at maximum setting of the gain control. It is obvious that practically any tube used in the first stage of this instrument will exhibit a certain condition of microphonic operation to some extent. However, it should be possible to use maximum gain without encountering a steady condition of microphonics.

### SIGNAL TRACER APPLICATIONS

The Signal Tracer is one of the simplest yet most effective instruments the service man can use for rapid, accurate trouble shooting in radio and TV circuits. In order that its operation be simplified, control manipulation should be held to an absolute minimum and of course this simplicity of operation demands that the tracer be of the untuned type. A high gain channel has been incorporated in the circuit which will permit the investigation of RF, oscillator and IF circuits in AM and FM radios as well as TV receivers. A special demodulator probe incorporating a Germanium diode, a blocking condenser and anti-loading resistor is used for this work.

This instrument features a number of definitely useful applications which will permit the service man to quickly locate and diagnose the difficulty being experienced in the circuit under investigation. Many of the tests will be performed automatically and will require only a few seconds of the service man's time. It is earnestly suggested that the builder thoroughly familiarize himself with all phases of instrument operation so that maximum benefits can be realized from the investment in this kit.

The procedure to be followed when using the T-3 Signal Tracer in service work will be outlined in a general manner. Obviously, through familiarity with its operation and use, the service man will develop a pattern of instrument use that will meet his particular requirements. Therefore the suggested instrument used should be construed as general application and does not necessarily represent the limits of the Signal Tracer operation.

### RF SIGNAL TRACER

To use the Model T-3 as an RF signal tracer, the RF probe must be connected to the RF screw type panel connector. The panel function switch should be set to the "Tracer" position. The RF switch to the ON position and the gain control advanced to approximately two thirds of its maximum rotation. The speaker panel switch should be in the ON position and since the Model T-3 Signal Tracer does permit visual observation of the signal, the user of the instrument may find it more convenient in certain applications to leave the speaker switch in the OFF position. The indicator tube on the panel will permit an approximate indication of signal level that is being observed. If the signal is extremely weak, the gain control of the tracer will allow sufficient reserve gain so that the signal can be observed quite readily. The overall gain of the Heathkit Model T-3 Visual, Aural Signal Tracer is adequate to permit direct observation of the actual transmitted signal of even a weak station.

To illustrate the use of this instrument, we may assume that a radio receiver is under test with the specific complaint of low volume. Since the receiver is in operating condition, it could be turned on and tuned to a familiar station. The volume control of the receiver should be reduced so that the speaker output will not interfere with the Signal Tracer results. The flexible ground lead of the RF probe should be clipped to the B minus or ground circuit of the receiver. The test probe can then be applied directly to the antenna terminal or to the antenna loop. Sufficient gain should be used to permit an indication of the signal level that is present. The probe can be moved through the input circuit to the antenna trimmer and tuning system to the grid of the mixer or converter tube. The path of the signal can be traced progressively from the plate of the mixer tube and to the IF stage grid. The output of the IF stage can be checked by applying the probe directly to the IF tube plate and then to the IF output transformer secondary. The signal can logically be traced through any additional IF stages that may be present and into the detector stage.

During these tests, an approximate estimation of gain per stage can be made and the degree of gain that is expected in a circuit can usually be determined through previous experience in making similar tests. It would be well to remember that in some cases, the RF probe may allow a slight detuning effect when applied to the tuned circuits and may induce oscillation. Rather than attempt to correct the receiver circuit for this condition, it would be advisable to advance the probe to the following test point and if a good signal indication is present, it would be reasonable to assume that the circuit is functioning properly.

The same general procedure can be used in checking RF and IF stages in radio and TV circuits. Obviously since the actual signal is the prime factor of consideration, the Signal Tracer will detect the presence or absence of a desired signal regardless of the type of circuit involved.

#### AUDIO SIGNAL TRACING

After detection has taken place in the receiver circuit, the use of the RF probe is not required and the audio probe should be used. To eliminate any possible confusion, the RF or high gain panel switch should be moved to the OFF position. The audio probe consists of a simple shielded probe and uses the low gain channel of the Signal Tracer. Here again, the same general conditions previously described apply to the use of the indicator tube and the speaker. From the detector stage, the signal can be traced through various coupling circuits through audio stages and the output transformer. These tests can be made very quickly and will conclusively indicate any circuit fault which would be evident by loss of signal or gain in succeeding stages. Faulty volume controls can be detected and open or intermittent audio coupling condensers can be quickly spotted.

It is interesting to note that the Model T-3 Signal Tracer will detect the presence as well as the absence of signal. For example, it is common practice to use a high capacity condenser in the cathode circuit of the output stage to bypass the bias resistor. In event this condenser is open, there will be a definite indication of signal at the cathode whereas a good condenser would bypass the signal to ground in the desired manner.

As a signal is traced through the audio system, the signal level will be extremely high and it will be necessary to reduce the setting of the Signal Tracer gain control. A definite reduction in gain will be noted as the probe is moved from the primary winding of the output transformer to the secondary winding. This, of course, represents an entirely normal behavior pattern.

#### WATTMETER

By the addition of a few circuit components, the T-3 Signal Tracer will serve as an extremely useful wattmeter. To use the instrument as a wattmeter, it is merely necessary to set the panel function switch to the wattmeter position and since amplifier gain is not required for this purpose, the gain control should be reduced to minimum. The AC plug of the receiver under test should be plugged into the AC receptacle provided on the panel of the Signal Tracer. The receiver should then be turned on and allow a few seconds for normal operating conditions to be

reached. The wattmeter control should then be adjusted for closing of the shadow angle in the indicator tube without allowing overlapping to take place. The power consumption can then be read directly on the calibrated wattmeter scale. Since it is common practice for receiver manufacturers to indicate watts consumption on the chassis label, it can be quickly determined whether or not the power consumption is normal. It would be reasonable to allow a tolerance of approximately ten percent.

The value of this test can readily be appreciated when consideration is given to the fact that any overload condition in the voltage distribution system of the receiver will definitely reflect in a relatively higher wattage consumption rating. For example, a shorted screen bypass condenser or a shorted filter condenser will provide a definite indication. Naturally when this condition is encountered, the receiver should be turned off and the source of the trouble located through the use of an ohmmeter and corrected before proceeding with further tests. A wattage consumption reading less than the indicated rating could conceivably be due to an open filament string in a transformerless type radio receiver or TV receiver. This particular test can be very quickly made and will produce a definite indication of overall receiver power consumption.

When using the wattmeter, some consideration should be given to the a-c line voltage. Variations in a-c line supply will cause corresponding variations in wattmeter indication. For example, a 200 watt incandescent lamp will check very close to the 200 watt figure when it is operated at 120 volts which, of course, is the normal rated voltage for the lamp. The same lamp at 110 volts actually requires only 182 watts. The wattmeter in your signal tracer has been calibrated at a 117 volt reference level as this represents the average voltage level usually maintained.

The useful range of wattmeter calibration will adequately measure the power consumption of small table model radio-receivers through the larger radio phono combinations as well as TV receivers. Bear in mind that in radio and phono combinations, the manufacturers label indicating wattage consumption refers to the combined operation of the radio and the phono mechanism and, therefore, suitable allowances must be made if power consumption measurements are to be made under these conditions. Quite frequently a radio and phonograph will be used in combination with a TV receiver and the wattage consumption will be for all three units.

An assortment of incandescent lamps can be used in various combinations to check the wattmeter calibration. It will be necessary to use a variac or Step-up transformer in order to simulate 120 volt line conditions for which these lamps are rated.

### NOISE LOCATER

A rather unique and definitely useful application of the T-3 Signal Tracer is its ability to locate noisy and intermittent components in various circuits. Basically the noise locating feature of the Signal Tracer permits the application of a DC test voltage to any component in the receiver circuit and the action of the DC voltage in the component is picked up and amplified in the Signal Tracer itself. This DC voltage of approximately 175 to 200 volts is available at the tip of the audio probe and of course the ground clip of the audio probe provides the necessary return circuit. Some precaution should be observed so that the service man will not encounter a relatively harmless shock hazard. The circuit arrangement is such that even under a dead short circuit condition of the ground clip to the test probe, the current drain will not exceed one mil and therefore the possibility of damage to a receiver component is eliminated. To use the T-3 as a noise locator, the following conditions should be observed.

First of all it is important that the receiver to be checked should be disconnected entirely from the AC supply line as all tests will be made on an inoperative receiver. The audio or low gain probe is used for this test and the panel function switch set to the Noise setting. As previously mentioned, a DC voltage in the order of 160 volts is now present between the probe tip and the ground clip



To illustrate an example of usage, the ground clip should be connected to a B plus supply point in the circuit. The test probe is then applied directly to the plate terminal of an IF tube. The gain control of the Signal Tracer should be at near maximum position. As the test probe is applied to the terminal of the IF tube, a sharp click will be heard in the Signal Tracer speaker. A good, clean click would indicate proper circuit continuity and operation. If there is any frying or crackling sound present, it would be reasonable to assume that some difficulty is being experienced along the circuit and then the test probe should be moved along each portion of the circuit in order that each component may be progressively checked. As the test probe is moved along through coils, resistors and other components toward the ground clip, it is quite likely that at some point the noise will disappear. When this condition occurs, the preceding step should be repeated and further investigation made of the particular circuit involved for a possible faulty component.

Noisy resistors will very definitely show up as a buzzing or crackling sound. The same condition holds true for a cold or rosin soldered connection in the receiver wiring. Shorted turns in IF transformers will also be evident by the noise content. The important thing to remember is that a satisfactory component will permit a sharp click to be heard in the speaker whereas a faulty component will result in a characteristic objectionable noise.

Obviously, the test voltage can be applied to any component in the receiver. For example, if an audio coupling condenser is suspected, the voltage can be applied across the condenser terminals and then the condenser jiggled or prodded to determine whether or not a noisy or intermittent condition may be present. Noisy volume controls or tone controls can be detected and of course the same condition holds true for the rotor section of variable condensers. Voltage can be applied to the condenser while it is being rotated and any shorting will be quickly evident. Of course, it will be necessary to disconnect any external circuit wiring connected to the condenser terminals.

Transformer windings that are faulty will also show up as noise in the Signal Tracer speaker. The continuity of windings can be checked and any leakage from winding to frame can be quickly determined.

There is practically no limit to the variety of useful applications afforded by this feature of the Signal Tracer, and it is suggested that the service man further investigate other test procedures in which the application of a DC voltage to a component in conjunction with a high gain amplifier will permit observation of the voltage action.

## PANEL CONNECTIONS

For additional flexibility of operation, the Signal Tracer panel features five binding posts. These binding posts differ slightly from the conventional type in respect that it is possible to insert a banana plug into the top of each jack. They will also accommodate alligator clips, spade lugs and conventional hookup wire. Test leads such as used in the VTVM can be used interchangeably with this instrument when required. The panel arrangement of the T-3 Signal Tracer will permit the utilization of other shop equipment for test procedure. For example, a VTVM can be connected either from B plus to P or from P to common or ground terminal. The VTVM would of course be switched to the AC position and the calibrated scale of the VTVM could be read directly for precise measurements during alignment procedure and gain calculations. The same terminals can be used for connecting to the vertical input of an oscilloscope. For additional amplitude, the vertical input of the scope can be connected across the full primary of the Signal Tracer output transformer and of course this would involve the use of both binding posts marked P. Obviously, the output transformer secondary connections could be utilized if the test requirements required the elimination of the DC voltage present in the primary circuit. A reduction in gain indication should be expected.

## TEST SPEAKER

In service work, it is frequently to remove the chassis of a radio or TV receiver to the repair shop in order to properly complete repair work. In practically every instance, the speaker is a separate piece of equipment and in some cases is installed in a rather inaccessible cabinet location. With the Model T-3 Signal Tracer at your disposal, it is not necessary to remove the speaker in view of the fact that the output transformer and speaker are available as test or substitution units. In the majority of cases, the original receiver circuit requirements specify the use of a permanent magnet type speaker and therefore the substitution can be very readily made. The advantage of using this feature of the Signal Tracer is readily apparent when consideration is given to the time and effort conserved by eliminating the necessity for speaker removal and re-installation on every service job. In addition, the possibility of damage to the speaker cone during the handling process is eliminated.

## AUDIO SYSTEM

Quite frequently the service man will be called upon to service automatic record changers or phono mechanisms and of course this equipment is usually removed from the cabinet of the receiver and transported to the service shop. While making mechanical repairs or adjustments to the changer mechanism, it is frequently desirable that the output of the phono cartridge be checked and actual conditions of tone reproduction simulated. Here again, it is a relatively simple matter to connect the low gain input of the T-3 Signal Tracer to the output cable of the record changer. The changer output as heard in the speaker of the Signal Tracer will permit detection of any irregularity in mechanical operation such as turntable "wow" or "thump" or any objectionable noise that could be transmitted through the phono cartridge and reproduced as an undesirable condition.

This same procedure could be used in checking microphones and musical instrument pickups and here again the results obtained are interpreted on the basis of comparisons made with previous tests on similar equipment. In an emergency, the Signal Tracer could be used as a high gain, low power public address amplifier. Of course, it could be used in checking FM tuners or other equipment requiring the use of an audio system.

## OUTPUT METER

The Model T-3 Signal Tracer can be used as an output meter merely by connecting the low gain to some point of the audio system in the receiver and regulating the amount of gain to permit usable action of the eye indicator. Then while performing alignment adjustments, the amount of gain or loss experienced in following a specific alignment procedure can be quickly determined. The Heathkit Model T-3 Signal Tracer will prove itself an extremely useful and versatile addition to any service shop. It is earnestly suggested that the user thoroughly familiarize himself with all phases of its operation so that he may obtain maximum benefits from his investment in this instrument.

## SERVICE

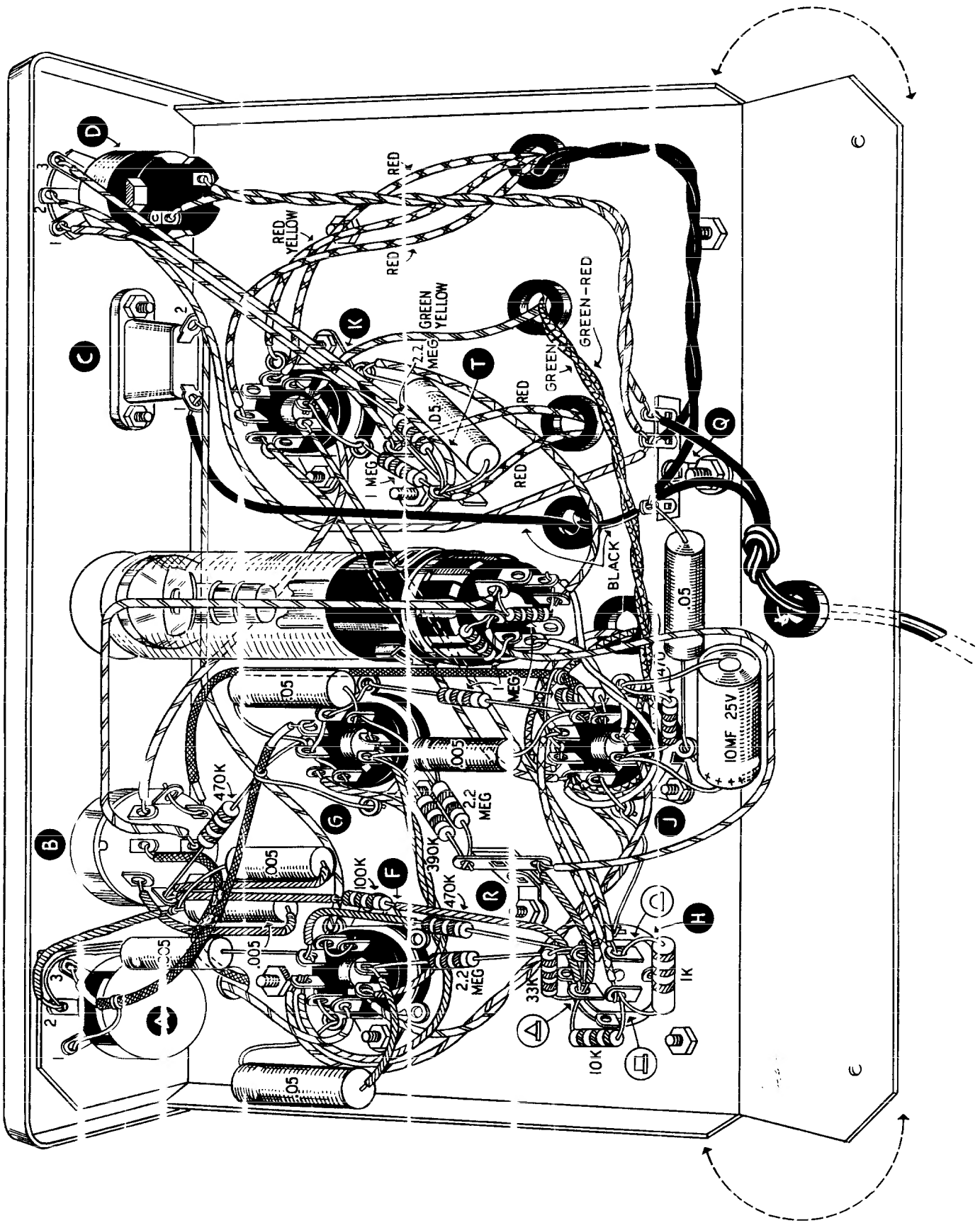
In event continued operational difficulties of the completed instrument are experienced, may we remind you that the facilities of the Heath Company Service Department are at your disposal. Your instrument may be returned for inspection and repair for a service charge of \$3.00 plus the cost of any additional material that may be required. **THIS SERVICE POLICY APPLIES ONLY TO COMPLETED INSTRUMENTS CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL.** Instruments that are not completed or instruments that are modified will not be accepted for repair. Instruments showing evidence of acid core solder or paste fluxes will be returned, not repaired.

## PARTS LIST

## MODEL T-3

PART No.	PARTS Per Kit	DESCRIPTION	PART No.	PARTS Per Kit	DESCRIPTION
Resistors			Sockets-Terminals-Plugs		
1-1	1	47 $\Omega$	260-1	4	Alligator clip
1-6	1	470 $\Omega$	260-2	1	Grid clip
1-15B	1	1000 $\Omega$ 2 watt	431-1	2	1 lug terminal
1-20	1	10 K $\Omega$	431-2	2	2 lug terminal
1-24	1	33 K $\Omega$	431-3	1	3 lug terminal
1-25	1	47 K $\Omega$	432-1	1	Connector
1-26	1	100 K $\Omega$	432-3	1	Connector
1-32	1	390 K $\Omega$	434-2	4	Octal socket
1-33	2	470 K $\Omega$	434-4	1	Octal socket
1-35	6	1 megohm	434-20	1	110 volt socket
1-37	4	2.2 megohm	436-1	1	Phone jack
Condensers			70-2	1	Insulator sleeve, black
23-2	5	.005 600 volts ✓	70-3	1	Insulator sleeve, red
23-6	1	.02 600 volts ✓	70-4	1	Insulator sleeve, acetate
23-10	4	.05 600 volts ✓	75-10	1	Insulator insert board
25-4	1	10 $\mu$ fd at 25 volts ✓	438-3	1	Phone plug
25-21	1	20-20-20-20 at 450 volts ✓	438-M8	2	Banana plug-sleeve assembly
Controls-Switches			439-M5	1	Black test probe
10-32	1	1 megohm	459-M2	1	Red probe tip end (tapped)
19-12	1	50 K with switch	459-M3	1	Black probe tip end
60-1	2	SPST slide switch	476-M8	1	Probe body-drilled
63-40	1	2 pole 3 position	477-3	1	Solderless phone tip
Tubes			Hardware		
411-17	1	6X5GT	100-M16	5	Thumbscrew
411-21	1	12A6	250-1	4	Self tapping screw
411-22	1	12C8	250-8	2	#6 sheet metal screw
411-27	1	12SH7	250-9	28	6-32 x 3/8" screw
411-30	1	1629	250-18	2	8-32 screw
Transformers			250-19	2	10-24 handle screw
51-10	1	Output Transformer	250-43	3	8-32 set screw
54-15	1	Power transformer	250-25	2	Screw
54-16	1	Watt meter transformer	252-3	34	6-32 nut
Knobs-Grommets-Feet			252-4	2	8-32 nut
73-1	6	3/8" grommet	252-7	5	Control nut
261-1	4	Rubber feet	253-1	4	Flat fiber washer
462-19	3	Skirted knob	253-2	5	Shoulder fiber washer
Wire-Spaghetti			253-10	4	Control nickel washer
89-1	1	Line cord	254-1	28	#6 lockwasher
340-2	1	#20 bare wire	254-2	2	#8 lockwasher
341-1	1	Black test lead	254-4	5	Control lockwasher
341-2	1	Red test lead	259-1	6	#6 solder lug
342-1	1	Shielded wire	208-2	1	Spring clip
343-2	2	Black shielded test	427-2	5	Binding post base
344-1	1	roll Hookup wire	481-1	1	Condenser mounting wafer
345-1	2	length Flat braid	Chassis-Cabinet-Panel		
346-1	2	length Spaghetti	90-14	1	Cabinet
			200-M31	1	Chassis
			203-36	1	Panel
			Miscellaneous		
			56-1	1	Germanium diode
			209-M1	1	Speaker grill
			211-1	1	Cabinet handle
			401-2	1	4" sneaker





PICTORIAL 3